Clear-sky TOA and Surface SW Comparison between CERES, Model and Measurements in CLAMS

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CLAMS (Chesapeake Lighthouse and Aircraft Measurements for Satellites) was a SW radiative closure experiment conducted in the summer of year 2001 to validate retrieval algorithms for aerosol and fluxes from CERES, MODIS and MISR.

TOA and surface SW between CERES, model and surface measurements for the four clear days in CLAMS are to be compared:

- (1). TOA radiance: CERES and model
- (2). TOA fluxes: CERES and model
- (3). Surface fluxes: CERES, model and surface measurements.

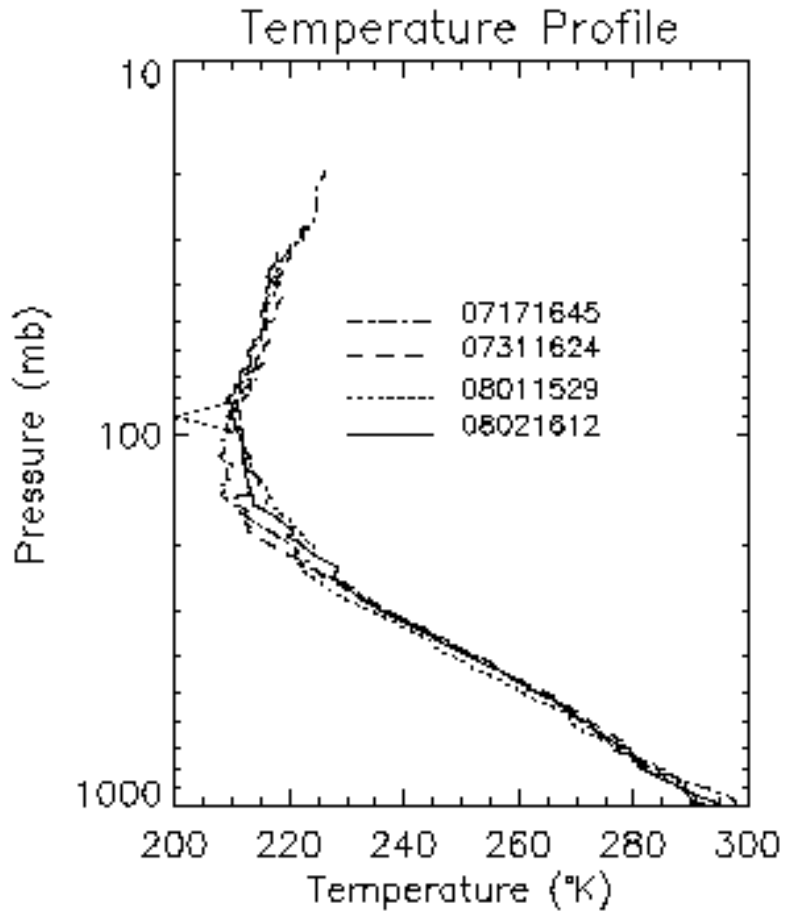
CERES FM2 was switched to a special programmed scanning mode to increase the frequency of measurement at COVE during CLAMS.

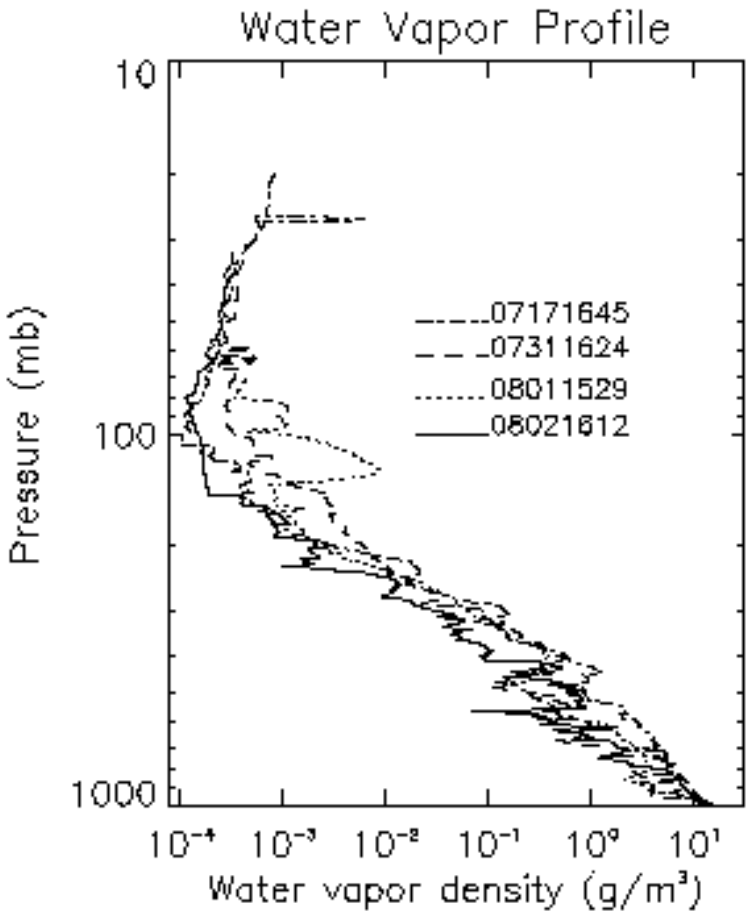
Criteria used to select CERES footprints for comparison:

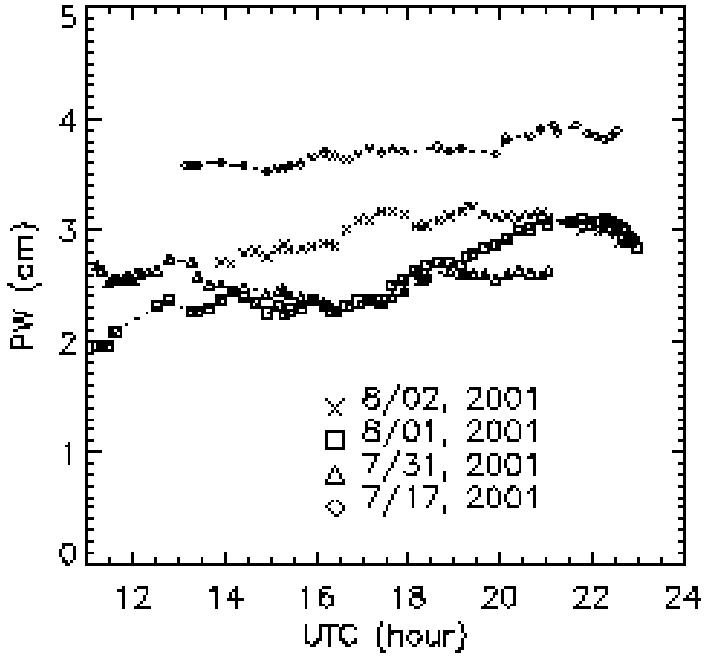
- Clear sky.
- Within 15km of COVE.

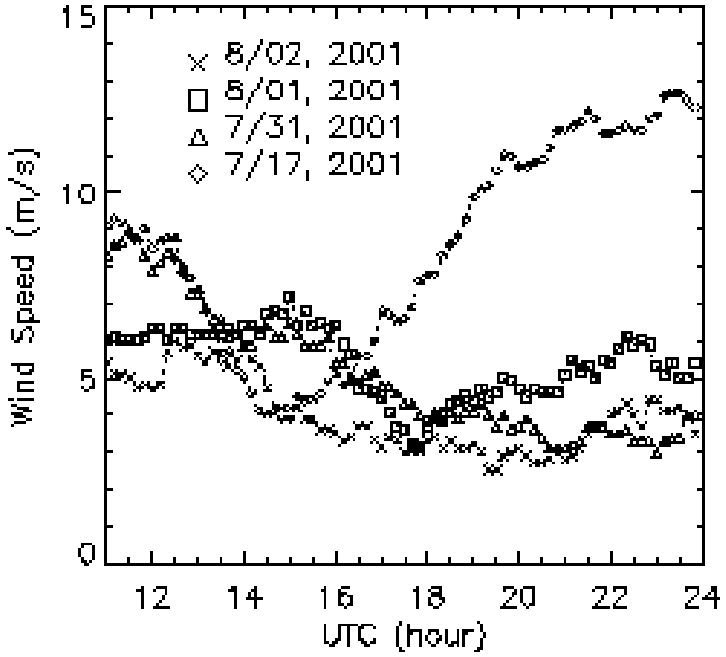
All model calculations are by COART (Coupled Ocean-Atmosphere Radiative Transfer model).

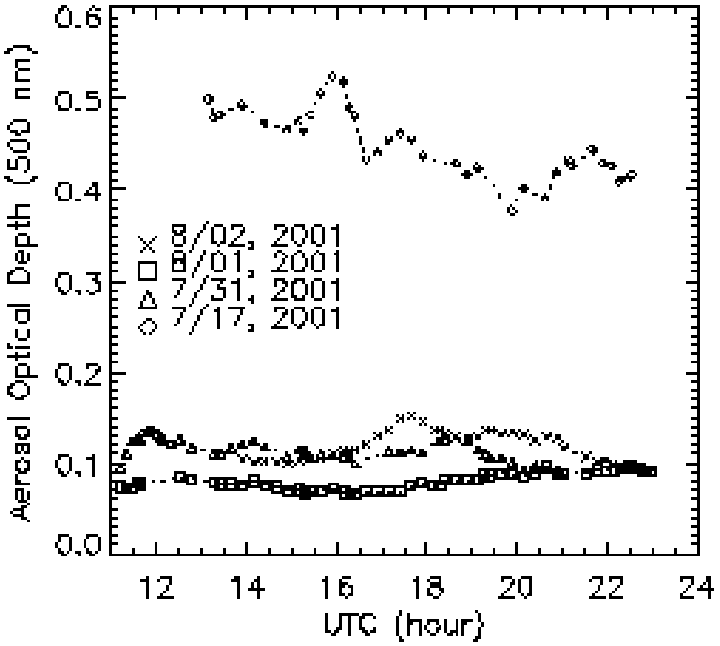
Temperature, Water vapor profiles at

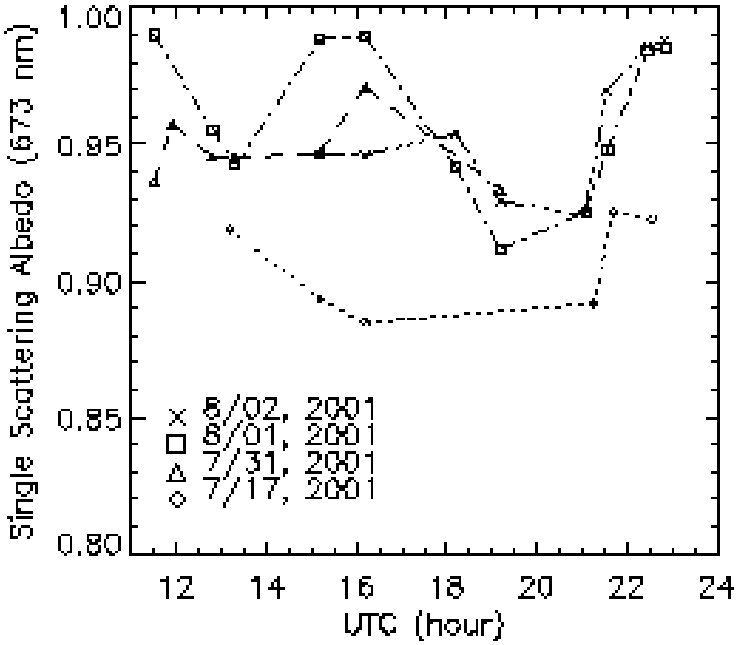


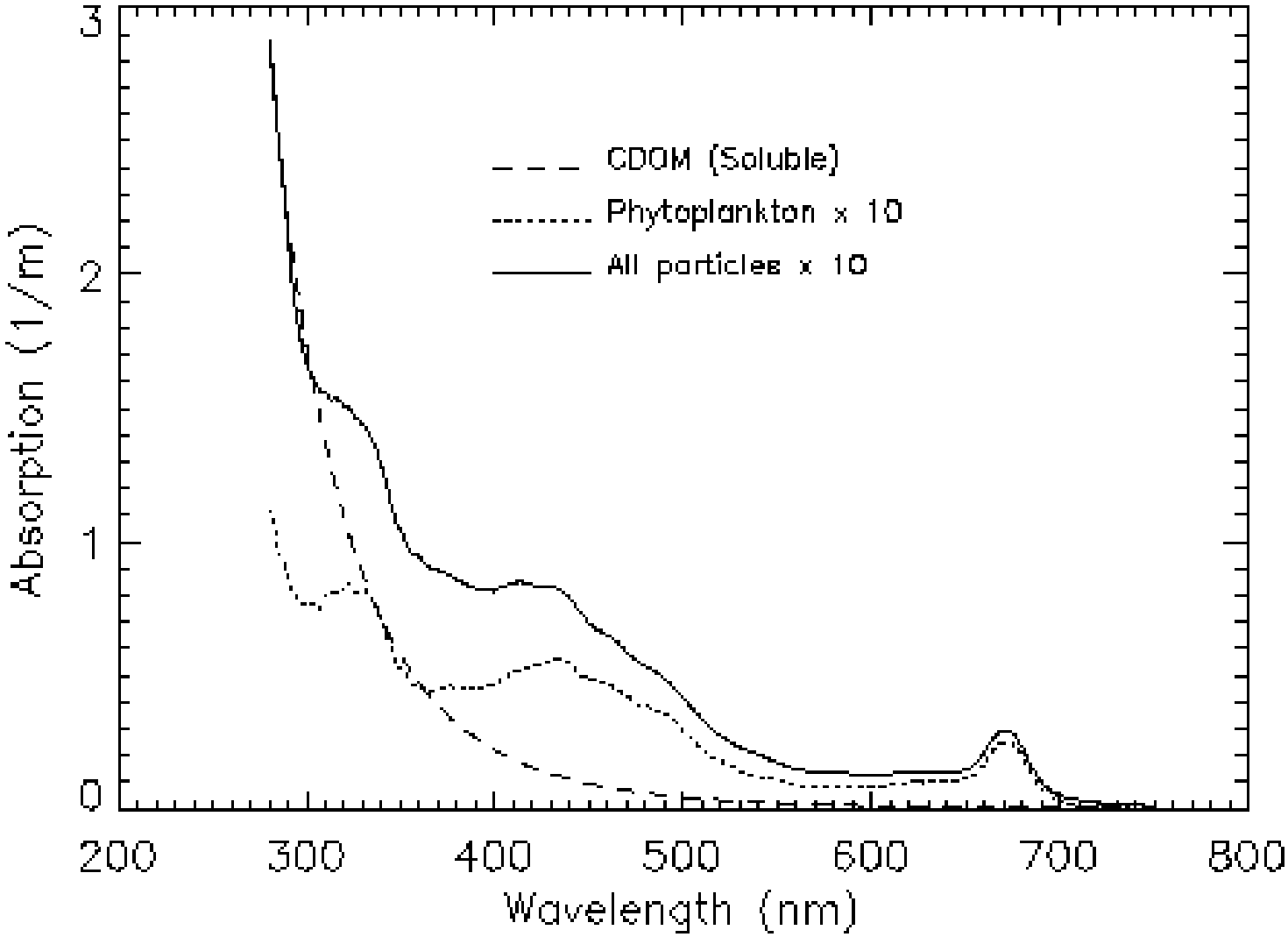



PW (cm)
UTC (hour)
8/02, 2001
8/01, 2001
7/31, 2001
7/17, 2001

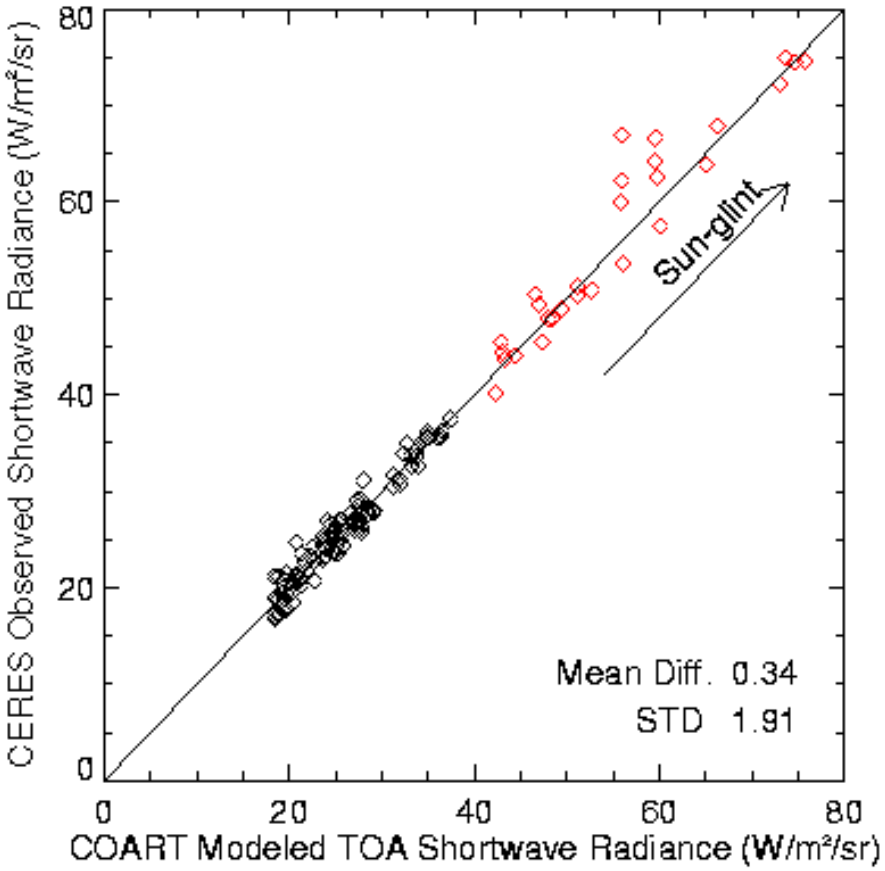

Wind Speed (m/s)
UTC (hour)
8/02, 2001
8/01, 2001
7/31, 2001
7/17, 2001

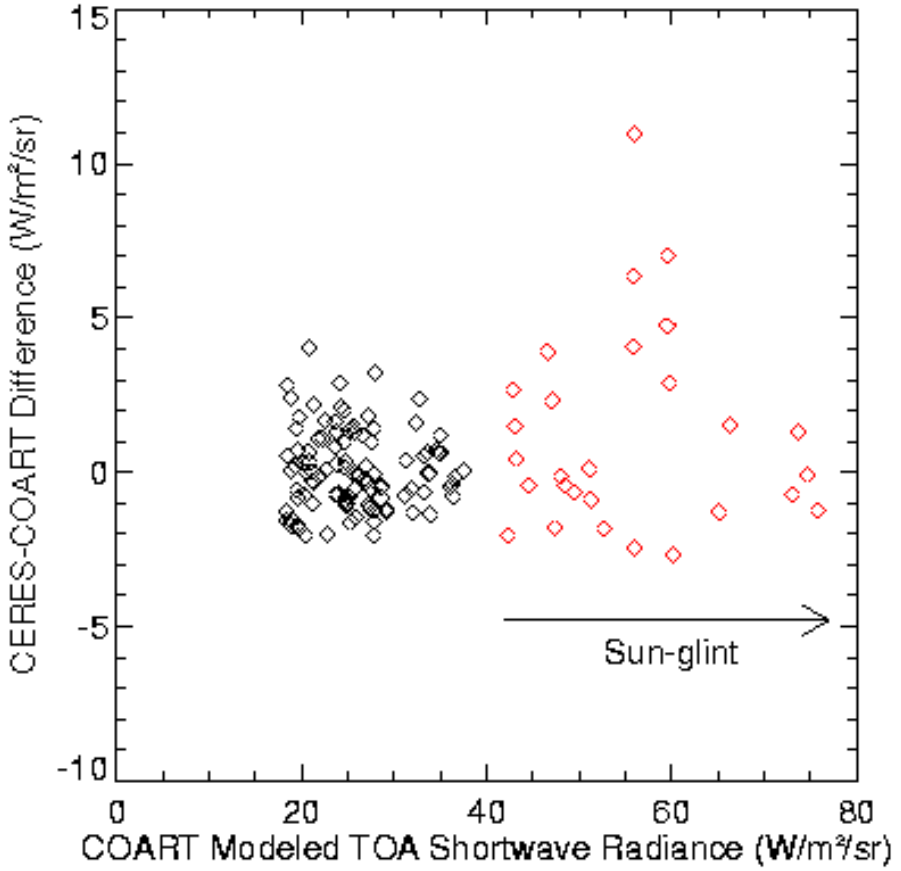

Aerosol Optical Depth (500 nm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
8/02, 2001
8/01, 2001
7/31, 2001
7/17, 2001
12
14
16
18
20
22
24
UTC (hour)


Single Scattering Albedo (673 nm)
0.80
0.85
0.90
0.95
1.00
8/02, 2001
8/01, 2001
7/31, 2001
7/17, 2001
12
14
16
18
20
22
24
UTC (hour)

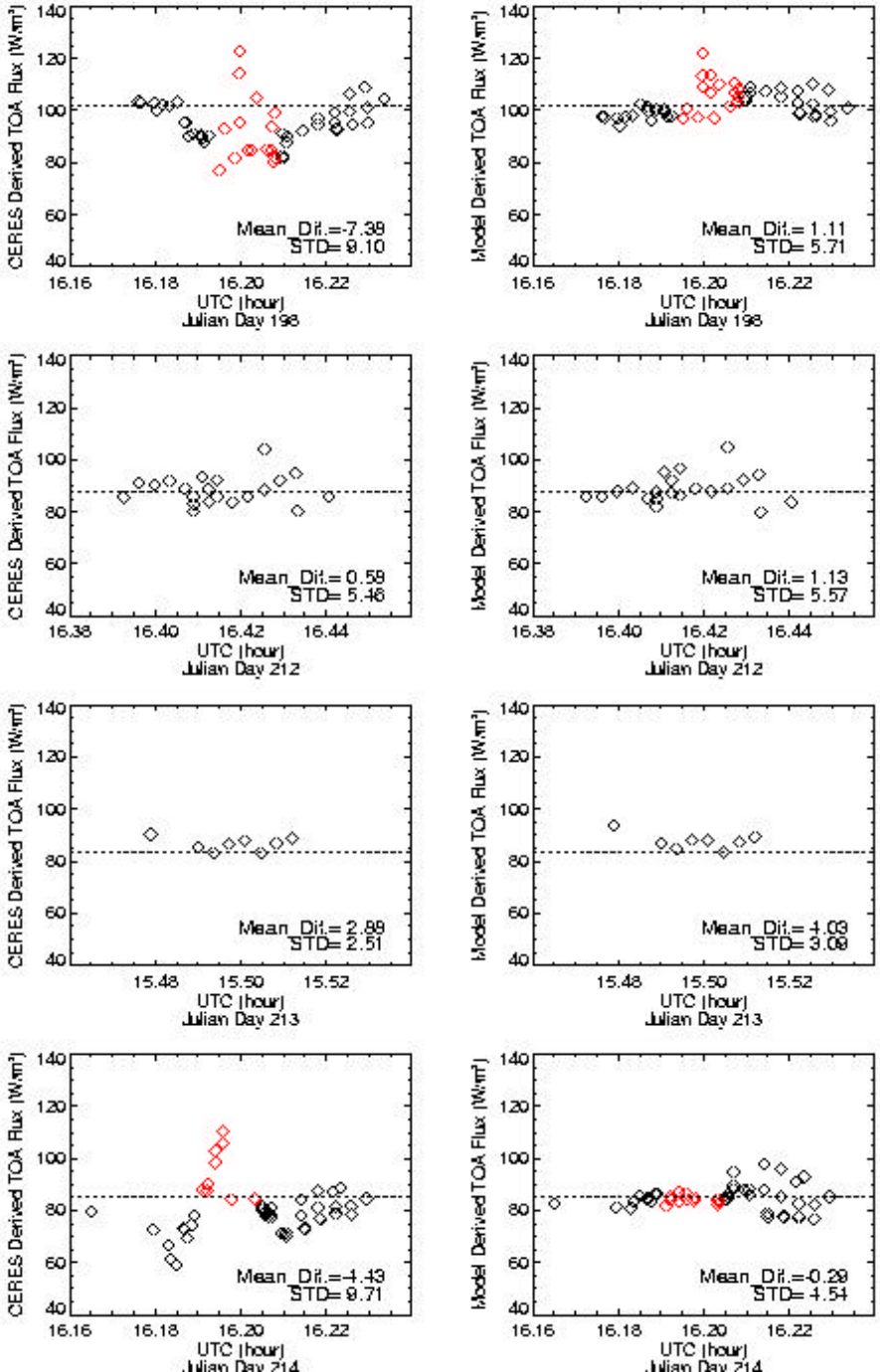

CDOM (Soluble)
Phytoplankton x 10
All particles x 10
Absorption (1/m)
Wavelength (nm)
0
1
2
3
200
300
400
500
600
700
800

CERES and Model TOA radiances

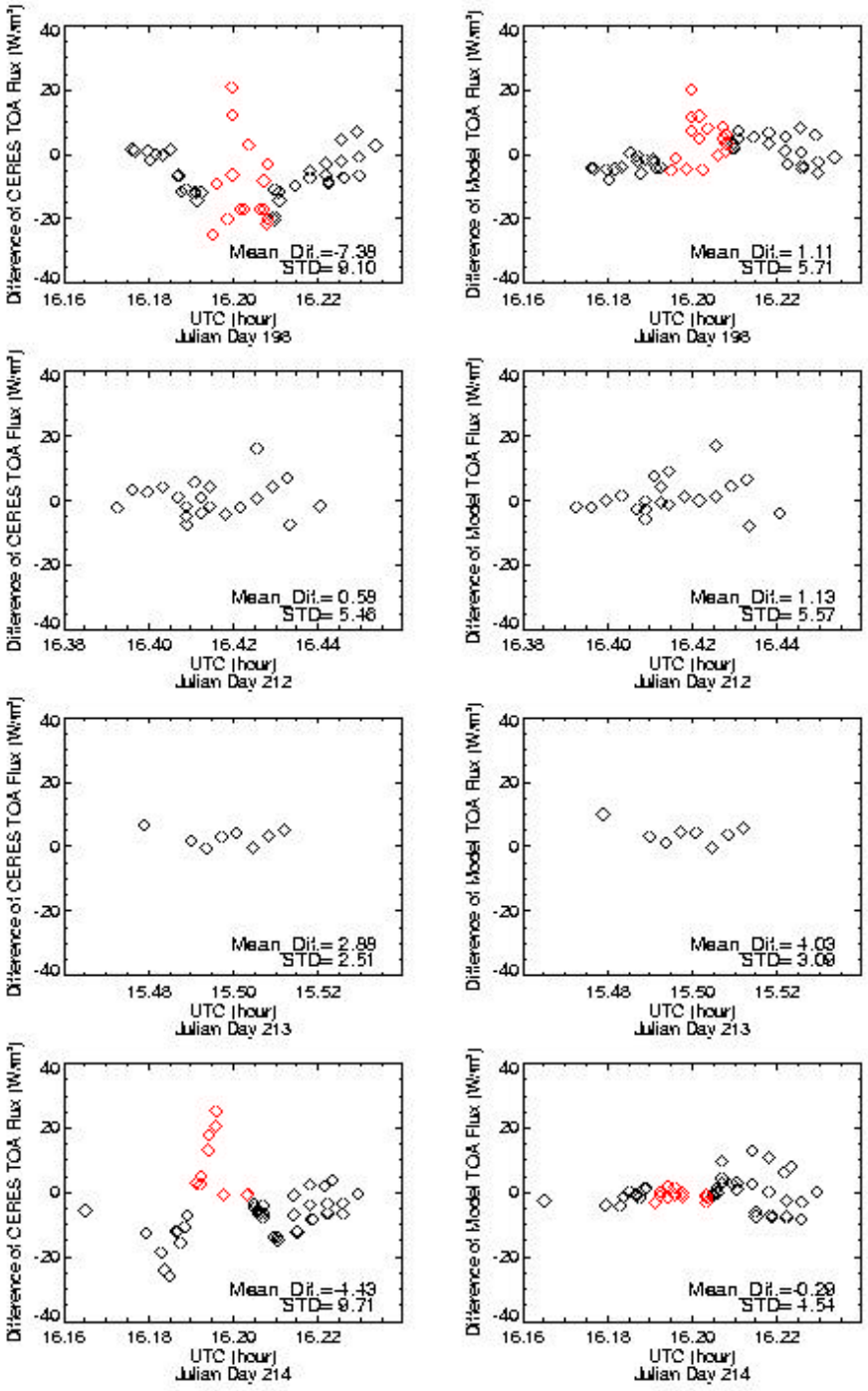




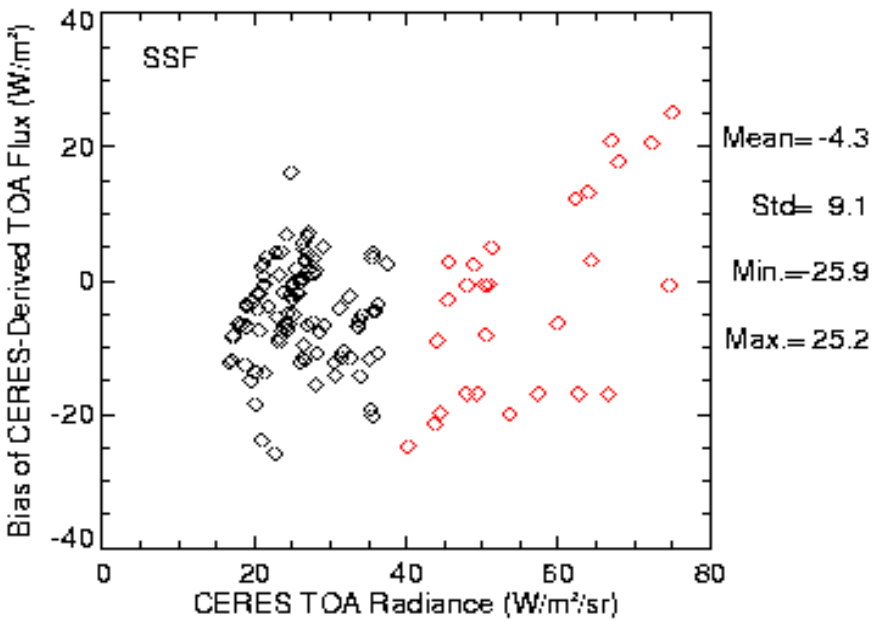
Comparison of TOA Fluxes

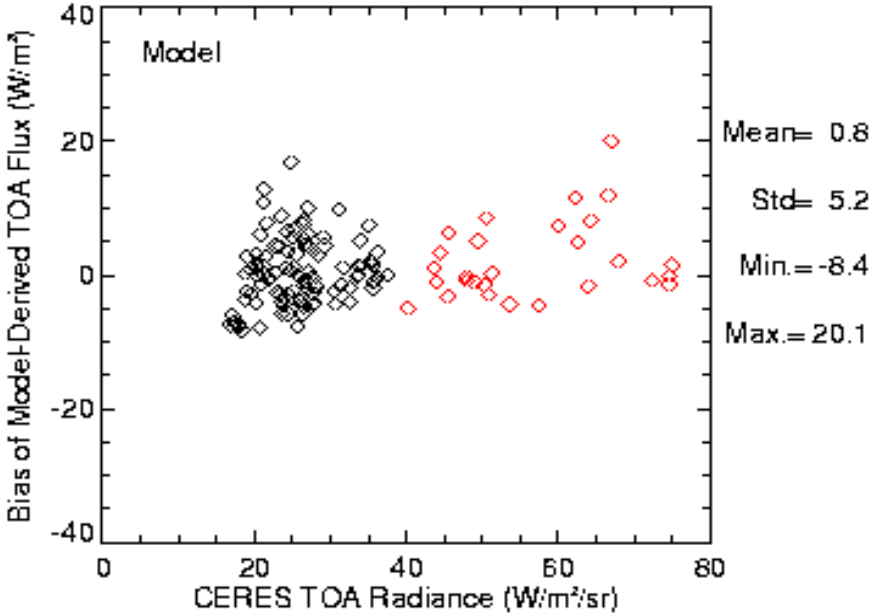


Comparison of TOA Flux Differences

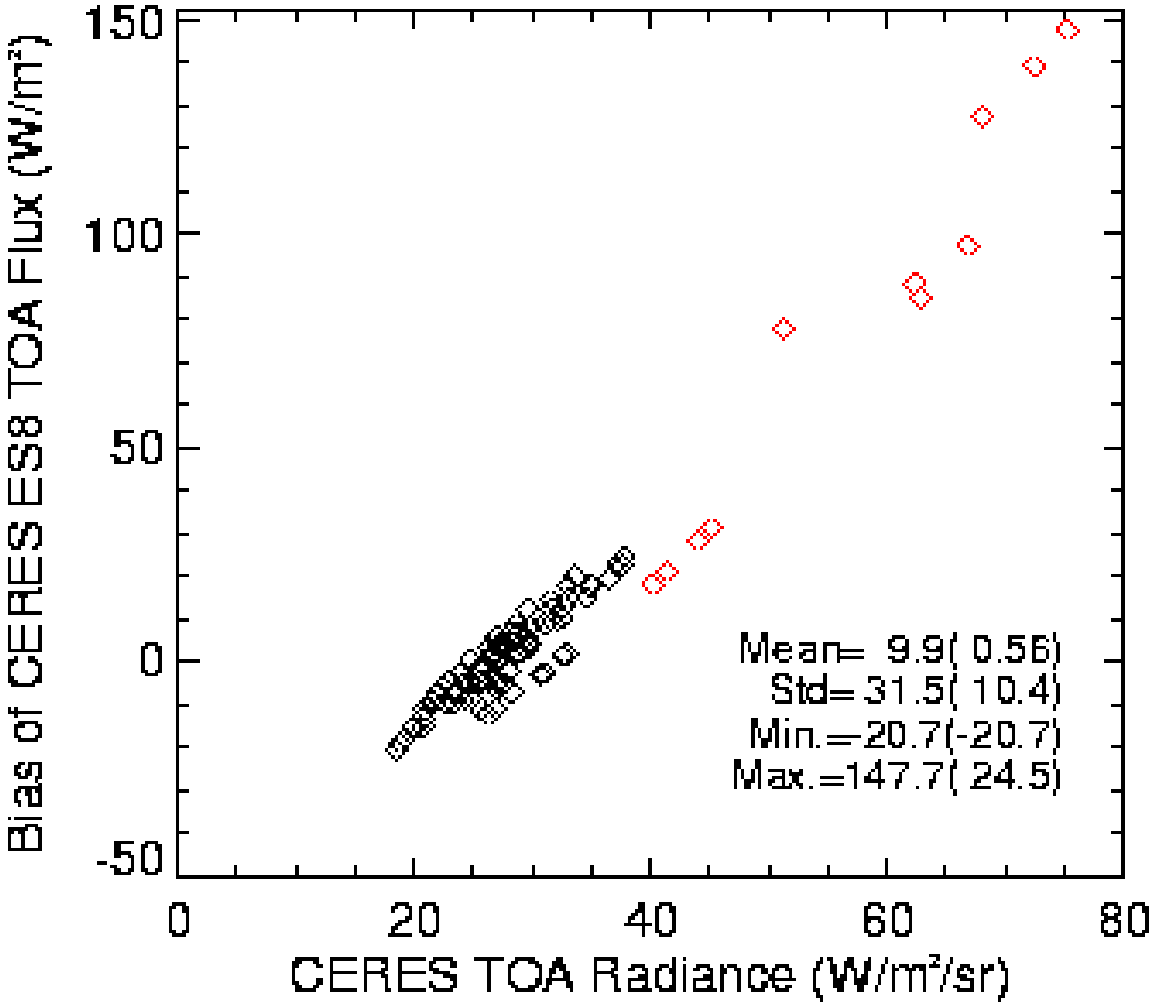


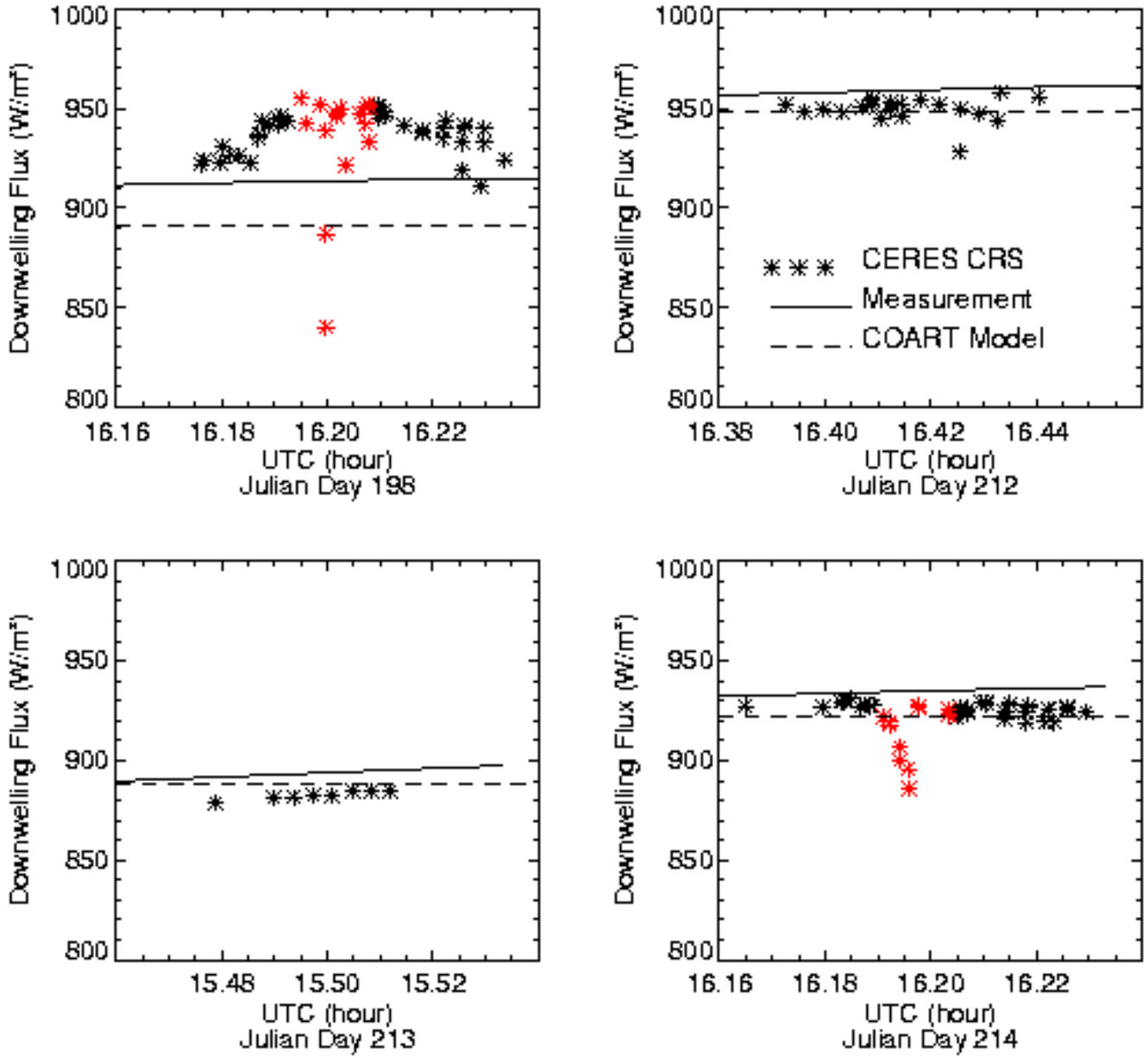
Bias of CERES TOA Fluxes





Bias of CERES ERBE-Like Fluxes

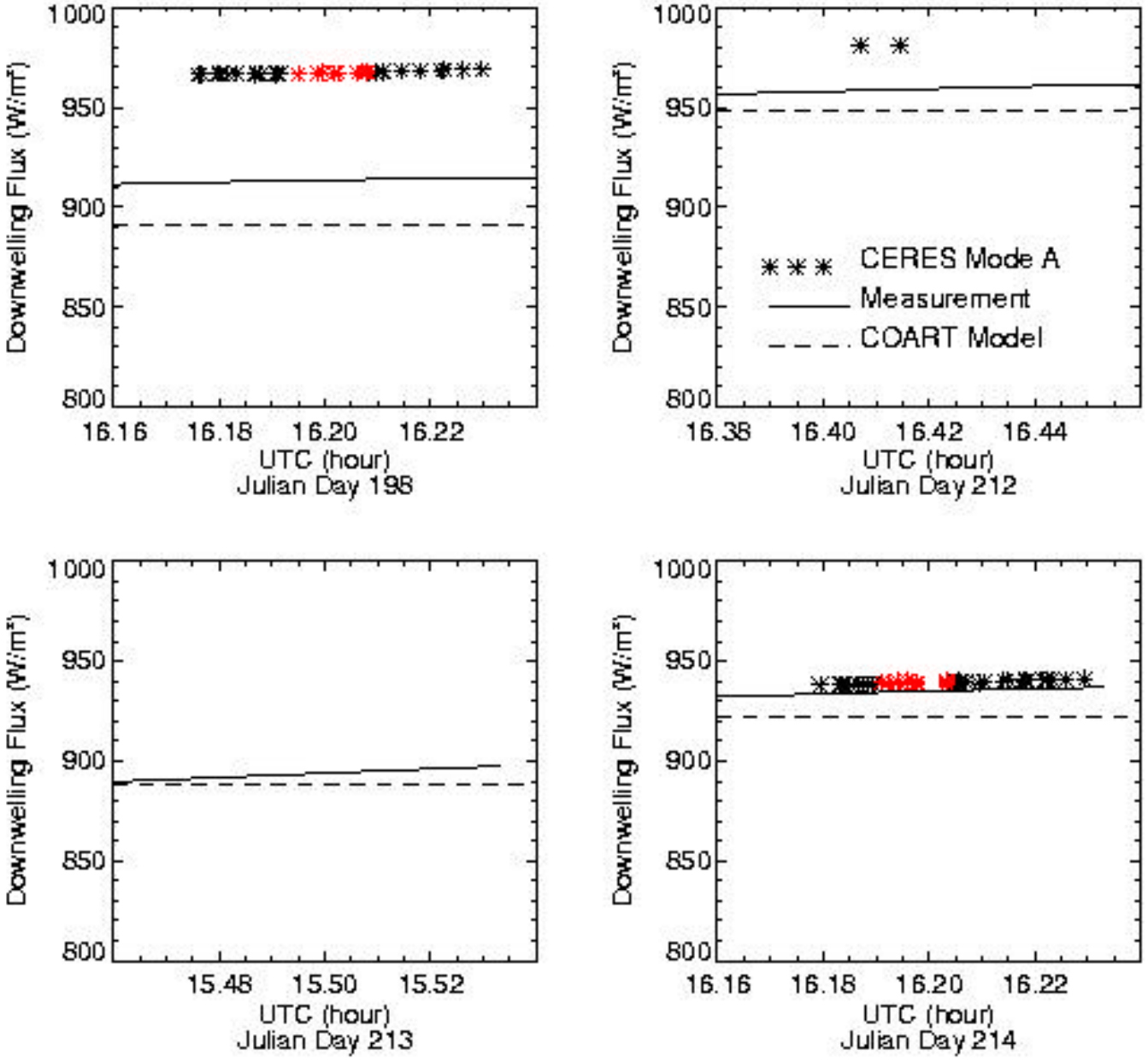




Comparison between surface measurement, model and CERES CRS

Diff_Mean(CERES-COVE) = 2.34 Diff_STD = 20.20

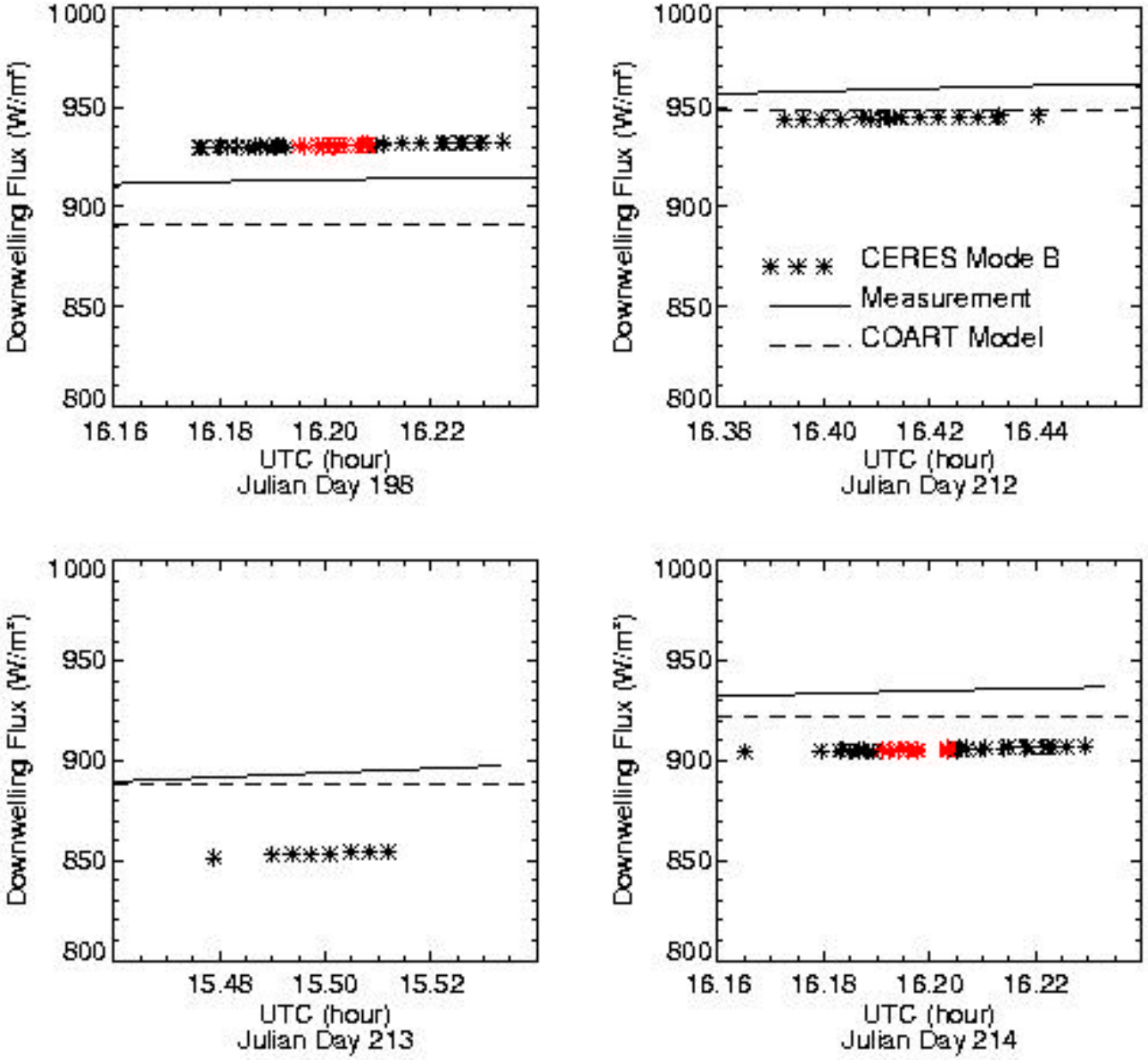
Diff_Mean(CERES-Model) = 18.06 Diff_STD = 25.28



Comparison between surface measurement, model and CERES Mode A

Diff_Mean(CERES-COVE) = 25.62 Diff_STD = 23.19

Diff_Mean(CERES-Model) = 42.24 Diff_STD = 28.76

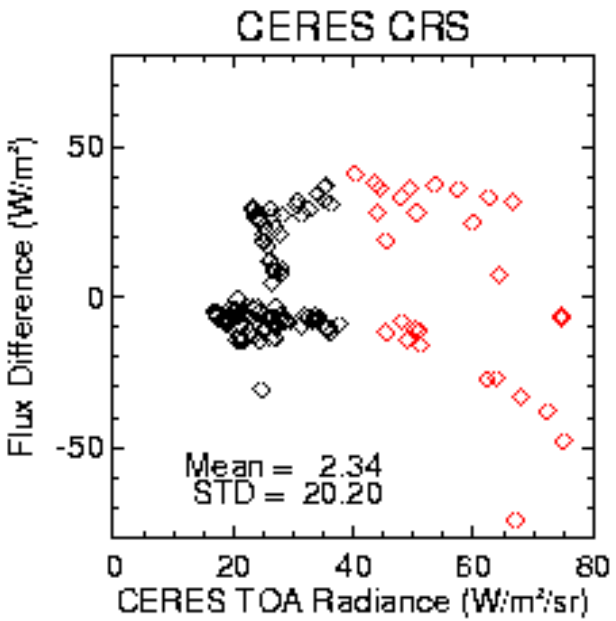


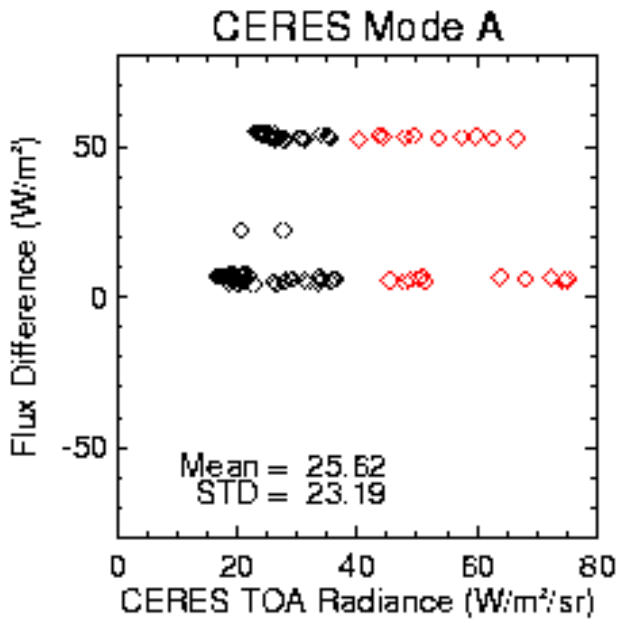
Comparison between surface measurement, model and CERES Mode B

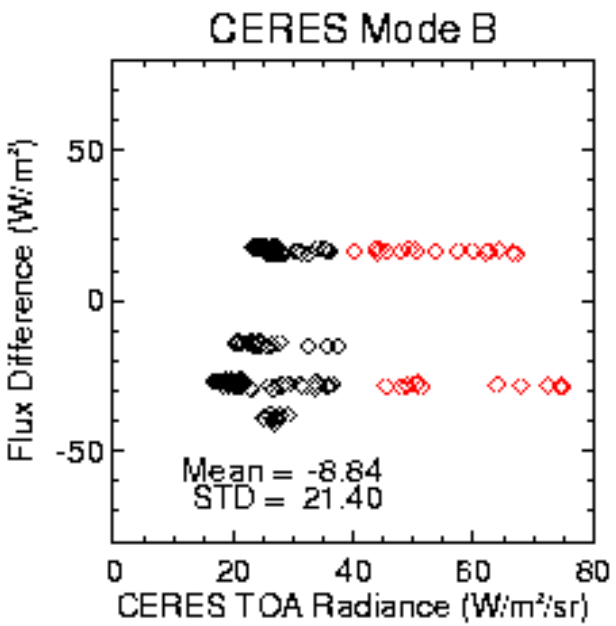
Diff_Mean(CERES-COVE) = -8.84 Diff_STD = 21.40

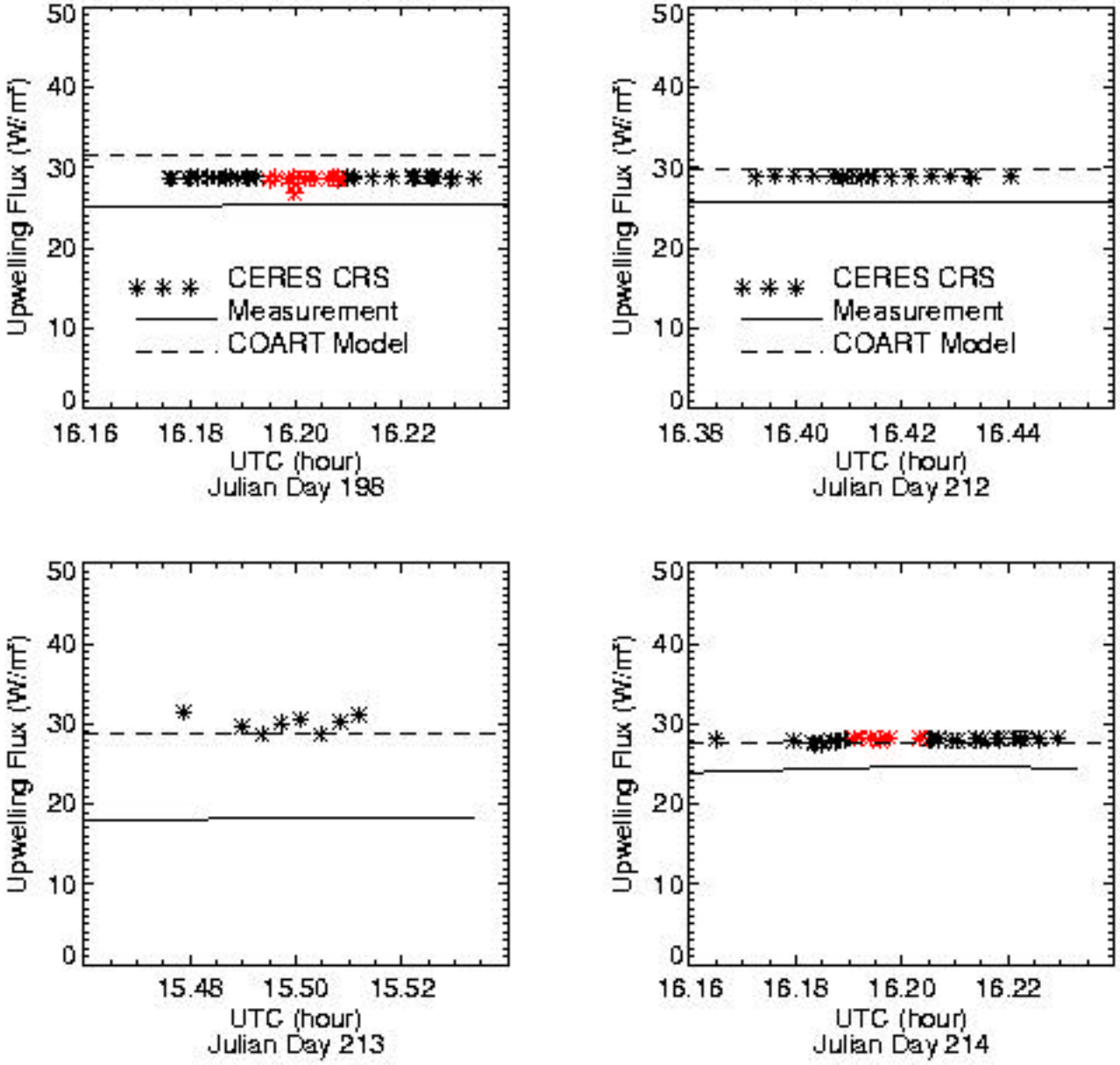
Diff_Mean(CERES-Model) = 6.89 Diff_STD = 27.56

Downwelling Flux Differences at Surface Between CERES and COVE Measurement





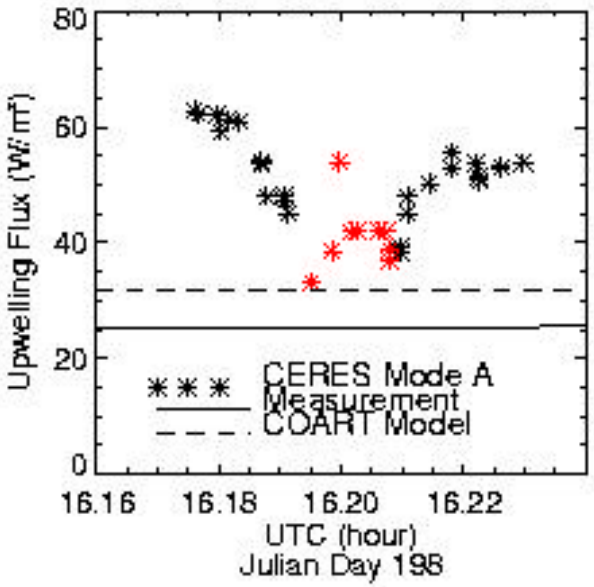


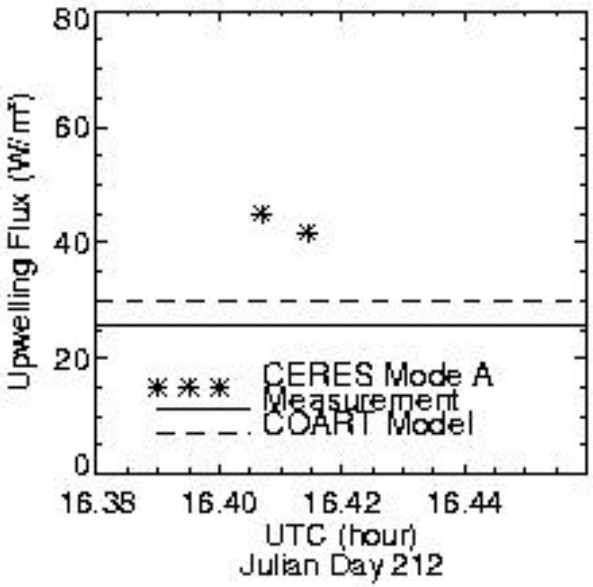


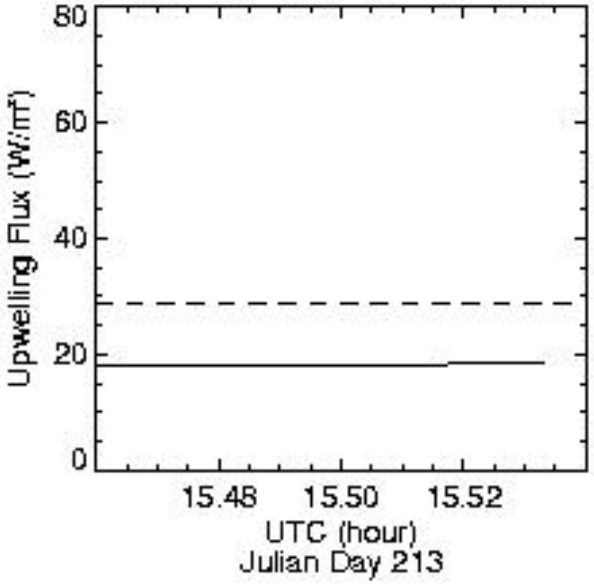
Comparison between surface measurement, model and CERES CRS

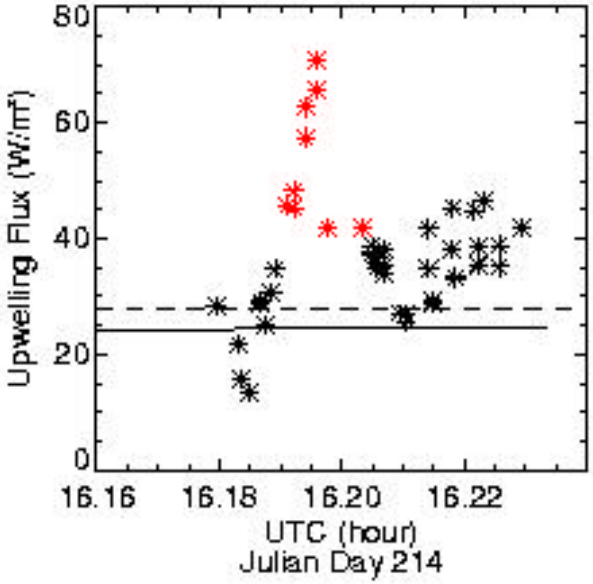
Diff_Mean(CERES-COVE) = 3.99 Diff_STD = 2.14

Diff_Mean(CERES-Model) = -1.10 Diff_STD = 1.59





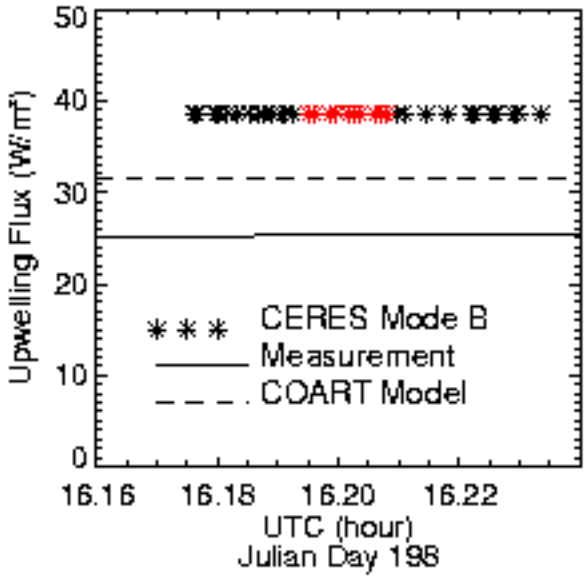


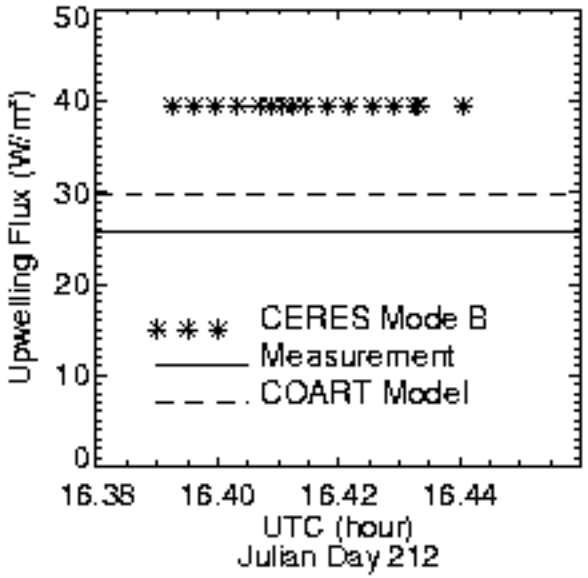


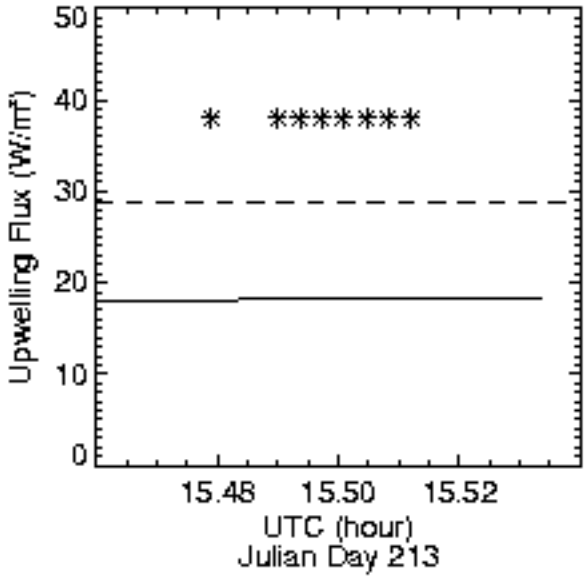
Comparison between surface measurement, model and CERES Mode A

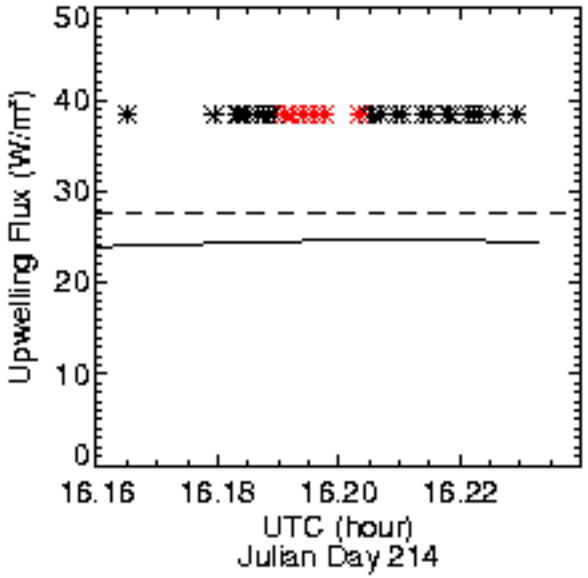
Diff_Mean(CERES-COVE) = 17.67 Diff_STD = 10.99

Diff_Mean(CERES-Model) = 13.06 Diff_STD = 10.49







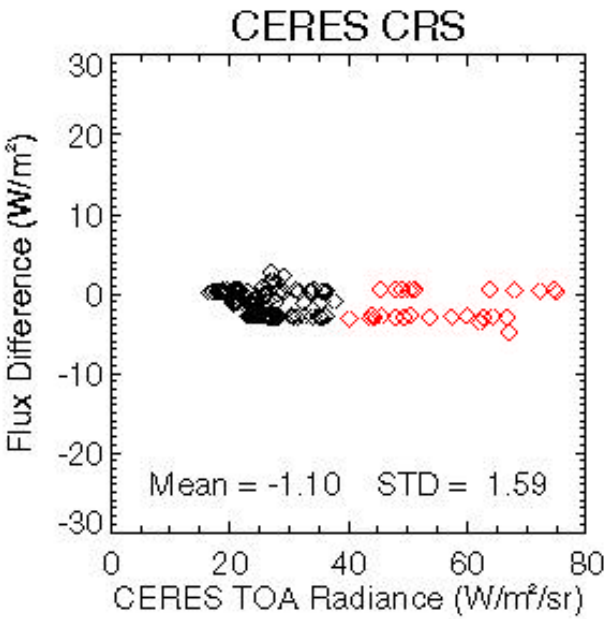


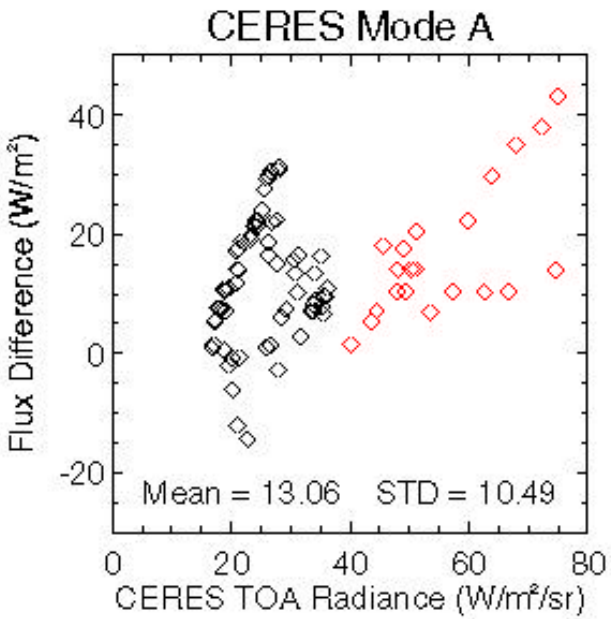
Comparison between surface measurement, model and CERES Mode B

Diff_Mean(CERES-COVE) = 14.05 Diff_STD = 1.61

Diff_Mean(CERES-Model) = 8.96 Diff_STD = 1.63

Upwelling Flux Difference at Surface Between CERES and Model





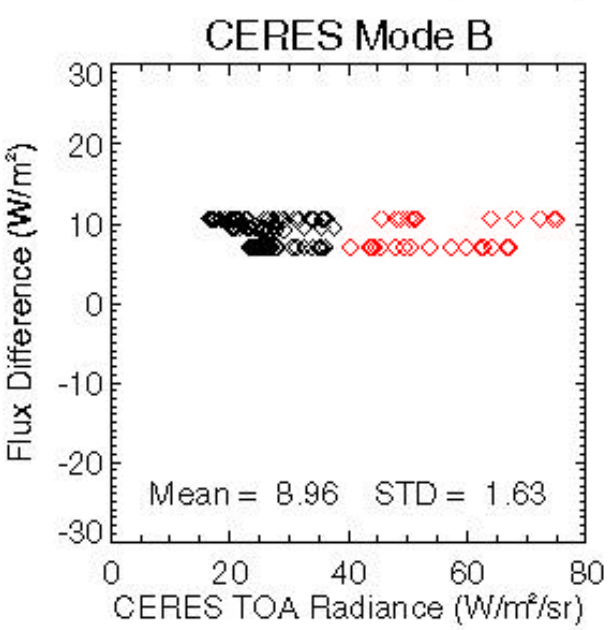


Table 1: Comparison Between CERES, Model and Surface Measurements

		All Data (sun-glint included)				*Data (sun-glint excluded)*			
		Mean	**Std(Std%)**	**Min**	**Max**	**Mean**	**Std(Std%)**	**Min**	**Max**
Radiance $(w/m^2/sr)$	CERES -Model	0.34	1.91(5.9)	-2.68	11.0	0.11	1.27(4.9)	-2.07	4.00
TOA	CERES	-4.3	9.1(9.9)	-25.9	25.2	-4.8	7.2(7.8)	-25.9	16.2
Flux	ES8	9.9	31.5(34.2)	-20.7	147.7	0.6	10.4(11.3)	-20.7	24.5
(W/m^2)	Model	0.8	5.2(5.7)	-8.4	20.1	0.3	4.9(5.3)	-8.4	17.0
Surface	CRS	2.3	20.2(2.2)	-74.3	40.7	2.0	16.0(1.7)	-30.7	37.1
Flux	Mode A	25.6	23.2(2.5)	4.1	54.7	25.1	23.0(2.5)	4.1	54.7
(Down)	Mode B	-8.8	21.4(2.3)	-40.7	18.2	-10.5	20.9(2.3)	-40.7	18.2
Surface	CRS	-1.1	1.6(5.4)	-4.8	2.7	1.0	1.5(5.1)	-3.1	2.7
Flux	Mode A	13.1	10.5(35.4)	-14.4	43.2	11.8	10.2(34.3)	-14.4	31.2
(Up)	Mode B	9.0	1.6(5.4)	7.0	10.7	9.1	1.6(5.4)	7.1	10.7

Summary

- Comprehensive radiative measurements provided a database for validation of model and satellite retrieval algorithms.
- CERES measured radiances agree well with modeled radiance in all directions, including the sun-glint region.
- CERES TOA fluxes have good agreement with model; ERBE-like TOA fluxes also agree well with model outside sun-glint region but show small systematic error and show large errors within the sun-glint .
- Downward fluxes from all three algorithms (CRS, Mode A, and Mode B) show good agreement with surface measurements and have relatively smallest deviations.

- For upwelling flux, Mode A and Mode B show large deviations, especially Mode A.
- Among three algorithms, CRS has smallest difference and STD, while Mode A has the largest.
- All data show smaller error outside the sunglint region.